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Observational evidence from α-elements in 67 dwarf stars in the solar neighbourhood

S. Feltzing, T. Bensby I. Lundström

S. Feltzing, sofia@astro.lu.se

Lund Observatory, Box 43, SE-221 00 Lund, Sweden

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We present the first results of a larger study into the stellar abundances and chemical trends in long-lived dwarf stars in the solar neighbourhood that belong to (based on their kinematics) the thin and thick galactic disk, respectively. We confirm that the trends of α-elements in the thin and thick disk are distinct (this has previously been shown for Mg by Fuhrmann 1998, but e.g. Chen et al. 2000 claimed the trends to follow smoothly upon each other). We find that the thick disk show the typical signature of contribution from SN *Ia* (*i.e. the "knee"*) *to the enrichment of the interstellar gas out of which the later generations of thick disk stars formed. The tre* 0.35 at [Fe/H]~ -0.7 and continue on this level with increasing [Fe/H] until -0.4 dex where a decline in [Mg/Fe] starts and steadily continues down to 0 dex at solar metallicity. The same is true for the other α-elements (e.g. Si). Using ages from the literature we find that the thick disk in the mean is older than the thin disk. Combining our results with other observational facts we suggest that the most likely formation scenario for the thick disk is, still, a violent merger event. We also suggest that there might be tentative evidence for diffusion of orbits in todays thin disk (based on kinematics in combination with elemental abundances). Stars: abundances, Stars:kinematics, Galaxy: abundances, Galaxy:disk, formation, Galaxy:solar neighbourhood Feltzing et al.

Introduction

Observational evidence revealed in the 1980's that the Galaxy has two disk-like components: the thin and the thick disks (Gilmore & Reid 1983). It is now also established that some, but not all, disk galaxies possess a thin and a thick disk and that the presence of a thick disk is often associated with mergers or interacting systems (Schwarzkopf & Dettmar 2000).

The stars in the thick disk have warm kinematics, $(\sigma_{\rm U}, \sigma_{\rm V}, \sigma_{\rm W})$=(67,38,35) km s^{-1}, and appear to all be old, e.g. Fuhrmann (1998). Its scale-height is 1000–1300 pc which is comparable to what is observed in other galaxies, Schwarzkopf & Dettmar (2000). The thin disk is more confined to the galactic plane with a scale-height of 300 pc and the stars have a cooler kinematics, $(\sigma_{\rm U}, \sigma_{\rm V}, \sigma_{\rm W})$=(35,20,16) km s^{-1}. Their metallicities are in the mean higher than those in the thick disk and extend up to super-solar values, Wyse & Gilmore (1995).

The chemical evolution of the thick disk, as traced by the stellar abundances in long-lived dwarf stars in the solar neighbourhood, has recently become a most active area of research, e.g. Fuhrmann (1998), Prochaska et al. (2000), Mashonkina & Gehren (2001), Chen et al. (2000), Gratton et al. (2000), and Tautvaišienė et al. (2001). However, the conclusions reached by these studies point in conflicting directions. While Gratton et al. (2000), Fuhrmann (1998), and Mashonkina & Gehren (2001) find that the star formation in the thick disk lasted less than 1 Gyr, Prochaska et al. (2000) infer a substantially longer time. Furthermore, three of the studies, Fuhrmann (1998), Chen et al. (2000), and Mashonkina & Gehren (2001), analyse the thin and thick disk stars in a differential manner. Chen et al. (2000) find that the chemical trends for the α-elements of the thin and thick disk stars, respectively, follow smoothly upon each other, while Fuhrmann (1998) and Prochaska et al. (2000) find the trends for the thin and the thick disk to be clearly separate. All the studies agree that the thick disk is old.

Here we report our first findings of a larger study that we have initiated in order to further characterize the two disks and also to find out to what metallicities the thick disk extends. Former studies have implied that the thick disk metallicity does not extend significantly above –0.5 dex. We discuss the implications of our first results from our southern sample. A northern sample is in preparation.

figure 6cm! toomre.ps Toomre diagram for our and Fuhrmann (1998) stars. Our thin disk stars are denoted by $\circ$ and thick disk stars with $\bullet$. Fuhrmann's thick disk stars are shown as and his halo stars as $*$. kin.fig